

SEC 110/0A/WO

## Claims

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1. A projection apparatus (1) for projecting an image onto a projection screen, comprising
- 10 an imaging device (11) that can be controlled pixel by pixel and is provided for representing the image at a reduced scale,
- an illumination unit (2) for illuminating the imaging device (11), and
- 15 a projection assembly comprising a projection lens (12) and provided for imaging the image represented by the imaging device (11) enlarged on the projection screen, wherein
- the illumination unit (2) comprises a dynamic color filter (5) for time-sequential mixing of primary
- 20 colors,
- characterized in that
- it comprises an optical outcoupling element (13) for coupling out a part of the luminous flux generated by the illumination unit (2) for illuminating the
- 25 imaging device (11),
- a sensor (15) for measuring the intensity of the light coupled out by the optical outcoupling element (13), wherein the intensity measured by the sensor (15) is a measure for the illumination level of the
- 30 imaging device (11), and
- a control unit which can be used to control the brightness and/or color of the projected image by controlling the imaging device (11) or by controlling

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the quantity of illumination light in relation to the signal (I) of the sensor (15), wherein

the outcoupling element (26) couples light out of the light path on its way from the illumination unit (2) to the imaging device (11).

2. A projection apparatus (1) according to claim 1, characterized in that the imaging device (11) is a Digital Micromirror Device (DMD).
3. A projection apparatus (1) according to any one of the preceding claims, characterized in that the dynamic color wheel (5) is a revolving color wheel (6).
4. A projection apparatus (1) according to any one of the preceding claims, characterized in that it comprises a spatial light mixing system (7) for compensating local differences in brightness distribution.
5. A projection apparatus (1) according to the preceding claim, characterized in that the spatial light mixing system (7) is a device, more particularly a light mixing rod (8), extending in the direction of light propagation.
6. A projection apparatus (1) according to any one of the preceding claims, characterized in that the outcoupling element (13) is arranged in the illumination path even while an image is projected onto a projection screen.
7. A projection apparatus (1) according to any one of the preceding claims, characterized in that the

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outcoupling element (13) is arranged permanently in the illumination path.

- 5 8. A projection apparatus (1) according to any one of the preceding claims, characterized in that the outcoupling element (13) is arranged in the illumination path between the illumination assembly (2) and the imaging device (11).
- 10 9. A projection apparatus (1) according to claim 4, characterized in that the outcoupling element (13) is arranged between the output of the spatial light mixing system (7) and the imaging device (11).
- 15 10. A projection apparatus (1) according to any one of the preceding claims, characterized in that the outcoupling element (13) is a semi-transparent mirror (14).
- 20 11. A projection apparatus (1) according to any one of the preceding claims, characterized in that the outcoupling element (13) couples out less than 5 percent, preferably less than 2 percent of the light.
- 25 12. A projection apparatus (1) according to any one of the preceding claims, characterized in that the sensor (15) is arranged in an optical plane which corresponds with the illumination plane (10) of the imaging device (11).
- 30 13. A projection apparatus (1) according to the preceding claim and claim 4, characterized in that the corresponding planes contain an image of the output of the spatial light mixing system (7).
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14. A projection apparatus (1) according to any one of the preceding claims, characterized in that it comprises a sensor optics (17) which is used to generate on the sensor (15) a reduced image of the illumination pattern of the imaging device (11).  
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15. A projection apparatus (1) according to any one of the preceding claims, characterized in that the sensor (15) is a sensor that supplies a brightness signal.  
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16. A projection apparatus (1) according to any one of the preceding claims, characterized in that the sensor (15) is a sensor with a two-dimensional local resolution.  
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17. A projection apparatus (1) according to any one of the preceding claims, characterized in that the sensor (15) is a sensor with spectral resolution.  
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18. A projection apparatus (1) according to any one of the preceding claims, characterized in that the sensor (15) is controlled by means of a clock signal of the dynamic color filter (5) such that it determines the light intensities pertaining to the primary colors and possible color-neutral portions separately.  
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19. A projection apparatus (1) according to any one of the preceding claims, characterized in that the intensity ( $I_L$ ) of the light generated by the illumination unit (2) can be varied over time and that this variation over time is considered in the evaluation of the signals ( $I$ ) of the sensor (15).  
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20. A projection apparatus (1) according to the preceding claim, characterized in that the variation in the intensity ( $I_L$ ) is based on a stabilization pulse (23) supplied to the lamp (3) of the illumination unit (2) and that the change in intensity of the lamp (3) caused by the stabilization pulse (23) is registered and considered by the sensor (15).
21. A projection apparatus (1) according to any one of the preceding claims, characterized in that it comprises a shielding (18) that surrounds the sensor (15) and is used to suppress retroreflections (19) from the imaging device (11) to the sensor (15).
22. A projection apparatus (1) according to any one of the preceding claims, characterized in that, in order to control the quantity of illumination light, it comprises a variable intensity reducer which is arranged in the immediate vicinity of the focal plane of the condenser system (4) or the focal plane of a focusing lamp reflector.
23. A projection apparatus (1) according to any one of the preceding claims, characterized in that the control unit can be used to control the projected image during running operation of the projection apparatus (1).
24. A projection apparatus (1) according to any one of the preceding claims, characterized in that the illumination unit (2) comprises a gas discharge lamp.
25. A projection apparatus (1) according to any one of the preceding claims, characterized in that it is a rear projection apparatus.

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26. A projection wall, comprising a plurality of projection apparatuses (1) according to any one of the preceding claims.

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27. A method for controlling the brightness and/or the color of a projected image of a projection apparatus (1) that is provided for projecting an image onto a projection screen, comprising

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an imaging device (11) that can be controlled pixel by pixel and is provided for representing the image at a reduced scale,

an illumination unit (2) for illuminating the imaging device (11), and

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a projection assembly comprising a projection lens (12) and provided for imaging the image represented by the imaging device (11) enlarged on the projection screen, wherein

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the illumination unit (2) comprises a dynamic color filter (5) for time-sequential mixing of primary colors,

characterized in that

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an optical outcoupling element (13) is used for coupling out a part of the luminous flux generated by the illumination unit (2) for illuminating the imaging device (11),

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a sensor (15) is used for measuring the intensity of the light coupled out by the optical outcoupling element (13), wherein the intensity measured by the sensor (15) is a measure for the illumination level of the imaging device (11), and

a control unit is used to control the imaging device (11) in a controlled manner and in relation to the

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signal (I) of the sensor (15) or to control the quantity of illumination light, wherein

5 the outcoupling element (26) is used for coupling light for the sensor (15) out of the light path on its way from the illumination unit (2) to the imaging device (11).

28. A method according to claim 26, characterized in that  
10 it comprises a feature of a projection apparatus (1) according to any one of claims 2 through 25.

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